SEASONAL DIMORPHISM IN BACCHARIS GLUTINOSA (COMPOSITAE)

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Baccharis glutinosa Pers. and *B. viminea* DC. are shrubs of ephemerally moist washes and the margins of permanent water courses at elevations rarely exceeding 5000 ft. They have been recognized as distinct species in several regional floristic treatments (Munz, 1959; Kearney and Peebles, 1951; Shreve and Wiggins, 1964). Mason (1957) notes, however, that the two species "are closely related and are not always easy to distinguish from each other." Recently Thorne (1967) has suggested that *B. glutinosa* is "doubtfully distinct from *B. viminea*."

Baccharis glutinosa has virgate stems with glutinous, lance-linear, usually serrate leaves and a terminal corymbose inflorescence. *B. viminea* has woodier stems and smaller, obscurely glutinous, entire leaves. The capitula are disposed in dense, cymose clusters at the ends of numerous, short, lateral branches. The former species blooms during late summer and fall, the latter usually between spring and early summer. This array of contrasting morphological features distinguishes the two taxa, but investigation of herbarium specimens and natural populations has revealed overlapping variation and evident seasonal differences, suggesting that *B. glutinosa* and *B. viminea* are conspecific.

I am grateful to James Henrickson who first initiated my interest and study of this problem and made available a photograph of the type of *B. viminea*. Acknowledgment is given to the curators of the herbaria at Rancho Santa Ana Botanic Garden, Stanford University and the University of California, Berkeley for loans of specimens. Dale M. Smith has read the manuscript and provided many valuable editorial suggestions.

Methods and Materials

Twenty plants in each of 21 large populations were randomly tagged during Feb. and Mar. 1967 (fig. 1). Sixteen of the tagged populations were situated in or near stream channels, one was located along the margin of a brackish slough and the remaining four occurred on relatively xeric sites. Two of the latter (Mill Creek and Oak Grove) were planted by the U. S. Forest Service for erosion control (N. Popovich, Arroyo Seco District, Angeles National Forest, pers. comm.).

Six characters were chosen for study: 1, number and 2, length of flowering branches disposed along the terminal two-meter segment of an erect woody stem; 3, the number of capitula per inflorescence; and

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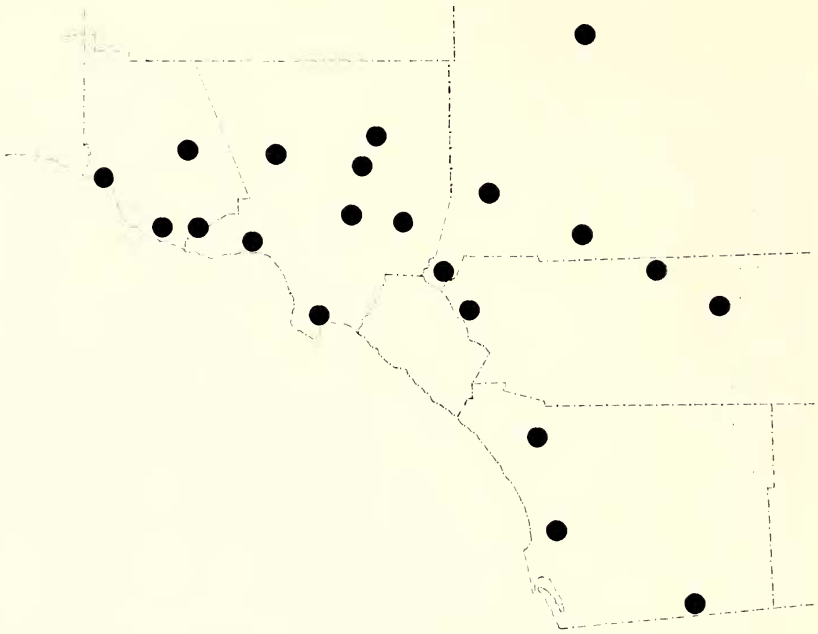

FIG. 1. Map of southern California showing locations of populations referred to in this paper.

4, the length, 5, width and 6, margin of 10 mature leaves from each plant. Each character was measured in all 21 populations during Mar. and Sept., 1967 with additional observations during 1968 and 1969. The data were analyzed by applying the "student's" *t*-distribution (Snedecor 1956). All comparisons between Mar. and Sept. samples for each population were significant at 5% unless otherwise noted.

Leaf margin was scored subjectively and consequently was not amenable to statistical analysis. Application of the terms *entire, denticulate* and *serrate* is exemplified in Fig. 2. Although *Baccharis* species are dioecious no significant differences were observed between staminate and pistillate plants for any of the characters studied.

RESULTS

Data derived from this study are summarized in Table I and the seasonal differences of five characters are demonstrated in Fig. 3.

The number and length of flowering branches are apparently inversely related as shorter, more numerous branches were produced in Mar. than in Sept. Not all twenty plants in each of five populations were in bloom during Sept.; consequently the range of population means was less than 1.0. The Ventura population exhibited no significant difference between Mar. (0.5) and Sept. (1.4) samples of flowering branch number although the difference in branch length was significant.

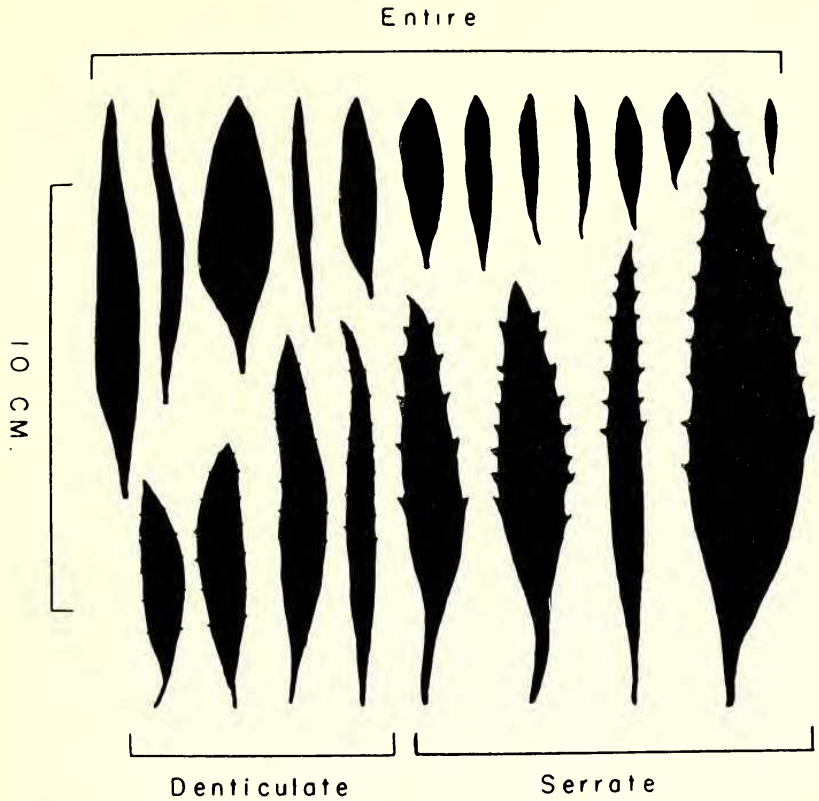

FIG. 2. Range of leaf variation observed during the course of the study with exemplification of the terms entire, denticulate and serrate.

Leaf length and width were generally greater during Sept. than in Mar. Seasonal comparisons of both characters in the Ventura, Pt. Mugu, Miramar and Harbor Park populations proved insignificant. Short, entire to denticulate leaves were observed most frequently during Mar., and the Sept. samples were usually distinctly serrate. Although a relationship between leaf size and margin might be expected the variation indicated in Fig. 2 suggests considerable plasticity of leaf morphology.

An attempt was made initially to score leaf glutinosity but no consistent method could be applied. Glutinosity does vary considerably, however, without any consistent correlation to population location or season. The most glutinous leaves were found in March samples of desert populations such as Little Rock and Whitewater.

The seasonal difference in the number of capitula reflects the difference in size of the Mar. and Sept. inflorescences. The dense lateral clusters of Mar. possessed fewer capitula and were smaller than the more open terminal inflorescences of Sept. Random measurements of both staminate and pistillate capitula height revealed a slightly larger

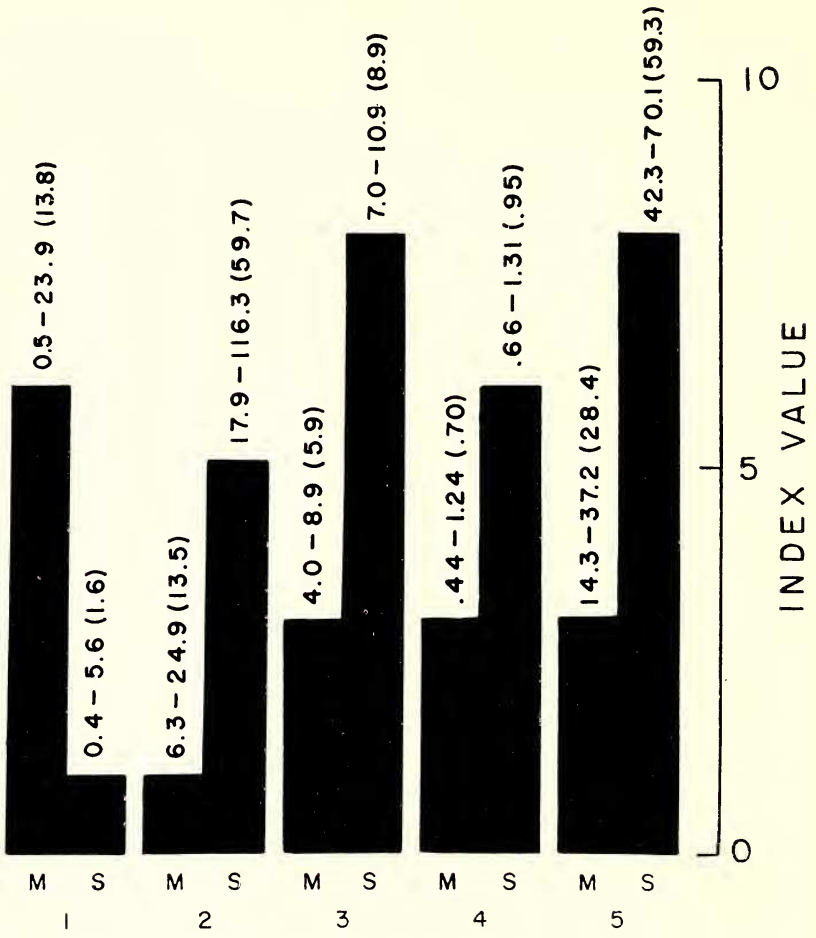

FIG. 3. Bar graph demonstrating seasonal differences of five characters in 21 populations: M = Mar.; S = Sept.; 1, number of flowering branches; 2, length of flowering branches; 3, leaf length; 4, leaf width; 5, number of capitula per inflorescence. Ranges of population means are shown for each character in Mar. and Sept. with the total mean given in parenthesis.

size in Mar. While examining herbarium specimens and living plants, attention was given to the bract margins. Those of *B. viminea* have been described as ciliolate in contrast to the scarous fimbrillate bract of *B. glutinosa*. No distinctive seasonal pattern was observed although the margins of mature outer involucral bracts are from one—three cells thick and bear short, biseriate, eglandular trichomes. Following anthesis the bracts reflex and fray along their margins resulting in a fimbrillate or erose condition.

TABLE 1. MEAN POPULATION VALUES FOR A SERIES OF CHARACTERS IN BACCHARIS IN MAR. AND SEPT.

Collection numbers are those of the author and the specimens are at UCSB. Serration: D = denticulate, E = entire, S = serrate.

	Number of Flowering Branches, cm		Length of Flowering Branches, cm		Leaf Length, cm		Leaf Width, cm		Number of Capitula per Inflorescence		Serration	
	M	S	M	S	M	S	M	S	M	S	M	S
Azusa *1382*	12.0	2.9	11.0	40.6	4.8	8.1	.66	1.05	17.6	60.1	D	S
Barstow *1405*	17.2	.8	12.1	109.2	4.2	10.4	.47	1.10	14.3	47.0	E	S
Bonsall *1319*	15.6	.9	14.6	39.6	4.8	8.7	.59	.82	31.3	57.5	D	D-S
Cajon *1407*	19.4	5.6	14.3	51.2	6.2	9.9	.80	1.07	35.4	60.2	D	S
Campo *1277*	8.3	.4	16.1	95.7	7.1	8.9	.63	.87	21.6	63.4	D-S	S
Harbor Park *1411*	6.4	2.4	23.8	31.6	8.0	8.3	1.03	1.09	33.7	70.1	S	S
Little Rock *1193*	23.9	.8	10.0	101.0	4.0	10.3	.68	.91	15.1	56.7	E	S
Mentone *1406*	19.1	1.9	9.7	36.2	4.1	8.5	.44	.67	30.1	48.4	E	D-S
Mill Creek *1412*	21.6	1.4	6.3	94.6	4.0	8.4	.56	1.00	23.3	59.1	E	D-S
Miramar *1298*	12.6	1.3	11.3	39.8	6.6	7.0	.69	.77	31.0	68.2	D-S	S
Oak Grove *1172*	13.7	1.2	12.5	48.5	5.8	8.0	.77	1.08	36.0	58.3	D-S	D-S
Pt. Mugu *1408*	9.1	2.5	23.4	27.9	7.6	8.7	.69	.79	29.6	67.9	D-S	S
Prado *1361*	11.9	1.7	12.9	42.5	7.5	10.7	.73	1.02	35.4	59.1	D-S	S
Saugus *1214*	19.8	1.7	11.6	49.7	6.5	8.9	.82	.96	22.5	67.6	D	S
Sespe *1235*	12.4	1.3	10.7	50.8	6.8	9.4	.77	.88	28.9	63.4	D	D-S
Sherwood *1409*	12.3	2.0	13.3	48.3	6.3	7.5	.63	.91	33.4	68.3	E-D	D-S
Temescal *1340*	9.4	1.1	11.1	54.3	5.0	7.6	.71	.82	36.7	55.3	E-D	S
1000 Palms *1404*	16.3	.7	14.2	116.3	7.4	10.9	.54	1.00	37.1	59.8	S	S
Topanga *1410*	13.3	1.6	11.9	32.6	5.8	7.9	.66	.82	29.6	60.1	E-D	S
Ventura *1256*	.5	1.4	24.9	33.9	8.9	9.7	1.24	1.31	37.2	54.3	D-S	D-S
Whitewater *1403*	16.1	1.2	8.5	111.4	4.5	10.5	.69	1.17	18.6	42.3	E	S
X =	13.8	1.6	13.5	59.7	5.9	8.9	.70	.95	28.4	59.3		

DISCUSSION AND CONCLUSIONS

The recognition of *B. glutinosa* and *B. viminea* as distinct taxa has depended on the variation of essentially two characters: the disposition of the flowering branches and the morphology of the leaf. The results of this study indicate, however, that the critical differences between these characters, hence the critical differences between the two species, are of a phenological nature rather than inherently genetic. This seasonal "dimorphism" is analogous to that occurring in *Pinguicula* section *Orcheosanthus* DC. (Casper, 1966). Species in this group showed marked morphological changes between summer and winter rosettes of leaves.

The range of variation observed during Mar. is comparable to that found on many herbarium specimens cited as *B. viminea*. The short, lateral, flowering branches bearing small entire leaves are initiated from axillary buds usually within one meter of the summit of the mature woody stems. The shortest of these are essentially compact cymose inflorescences and occur near the summit. The branches are progressively longer and are more widely spaced on the axis below. Herbarium specimens of the latter are often labeled *B. glutinosa* since in all respects they appear as terminal inflorescences on herbaceous shoots. Usually

such specimens are intermediate in regard to leaf morphology. After anthesis most of the lateral branches die back to the stem. This is followed by growth of a few herbaceous shoots derived either from nodes near the base of the plants or along the erect stems. The leaves of these shoots differ markedly. They are longer, wider and usually distinctly serrate; rather than being clustered they are well spaced along the stem. These herbaceous shoots complete growth late in the year and produce terminal corymbose inflorescences characteristic of *B. glutinosa*.

In successive years, the erect herbaceous shoots undergo secondary growth and become distinctly woody. Continued addition of herbaceous shoots results in the characteristic broom-like appearance of older shrubs. Many of the populations examined during this study continued to bloom at a reduced level throughout the year. Although the short inflorescences near the summit of the main axis develop and mature centripetally, branches ranging from 10–50 cm in length and ranging to two meters below the apex may produce inflorescences sporadically throughout the year. In addition, not all the plants in a population may be in bloom at any given time.

The variation observed in this study may be in part attributable to environmental modification. Desert and montane populations (i.e., Barstow, Whitewater, Mill Creek), subject to seasonal extremes in temperature, typically had a greater number of flowering branches in Mar., longer flowering branches in Sept. and the largest serrate leaves. Coastal stations (i.e., Ventura, Pt. Mugu, Harbor Park) under the influence of a more equable climate, in contrast, exhibited the least seasonal variation of any of the populations examined.

Their occurrence near a source of abundant water might preclude an environmental effect by this factor. A number of the populations observed, however, are annually subjected to spring and summer flash-floods, a common phenomenon in the area studied. Plants damaged by such events rarely attain the broom-like appearance of undisturbed shrubs. Occasionally observed during the investigation was the initiation of erect herbaceous shoots from the fallen branches. These were often seen bearing large serrate leaves and occasionally had terminal inflorescences while neighboring undamaged plants possessed inflorescences and leaves characteristic of *B. viminea*. Such a situation in fact first suggested the problem and the approach used in this investigation.

The genus *Baccharis* is best represented in Central and South America. Species occurring in the United States are distributed primarily in the south and southwest (i.e., *B. halimifolia, B. emoryi, B. sergiloides*) and are probably of Neotropical-Tertiary origin. This is reflected in part by the retention of the summer and fall blooming habit. The taxon considered in this paper is unusual in respect to the floral phenology of the genus as a whole since it has been demonstrated that, at least in the area studied, flowering begins between February and March and con-

tinues throughout the summer and well into fall. This habit may be of adaptive value in promoting seed production which, in combination with the exceptional dispersability afforded by light achenes and fine capillary pappus, could result in a greater potential for wide geographic distribution. Dioecism and a prolonged flowering period might, in addition, favor maximum genetic exchange and heterozygosity within a population. A broad and disjunct distribution of populations, particularly as occurs in the arid southwest, might on the other hand restrict gene flow and foster intrapopulation uniformity and interpopulation variation within the species. The differences between desert and coastal populations referred to earlier may well be the result of such genetic variability.

Baccharis glutinosa was first described from material apparently collected in Chile. The species in a broad sense ranges from Califorina to Texas and southward throughout much of Mexico to Guatemala and Honduras. It occurs disjunctly in Peru and Chile. Blake (1926; 1930) has reviewed a number of cases of synonymy for *B. glutinosa,* derived from his studies in European herbaria. DeCandolle applied the name *B. viminea* to a collection made by Douglas "in California." Careful examination of a photograph of the type revealed leaves ranging from two to four cm. in length and with entire to denticulate margins. From herbarium records, all specimens referrable to *B. viminea* indicate a completely "sympatric" occurence with *B. glutinosa.* From the data presented it is apparent that the differences between the two taxa represent a case of seasonal dimorphism and that specimens of *B. viminea* are merely phenological variations of the species *B. glutinosa.*

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